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EFFECTS OF STRYCHNINE ON THE BEHAVIOR OF GREAT HORNED OWLS AND RED-TAILED HAWKS

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ABSTRACT.—Objectives of this research included determining effects of dietary strychnine on raptor behavior. Toxin doses (0.8–2.3 mg/kg) were in the range of those possibly ingested when eating poisoned rodents in the wild. A series of experiments determined dose-response relationships in terms of movement, balance and severity of tremors and seizures. In addition we determined that subjects did not avert to strychnine-contaminated prey but did avert when lithium chloride induced gastrointestinal illness. Finally, effects upon foraging ability were ascertained. Doses of strychnine appeared to alter behavior such that subjects failed to switch patches efficiently. Sublethal doses of strychnine obtained in the wild from eating poisoned rodents can have deleterious effects on raptors. Constraints and implications of this conclusion are discussed.

Strychnine has been used for many years as a rodenticide on both forest and rangeland primarily in grain baits to control pocket gophers (*Thomomys* spp.), ground squirrels (*Spermophilus* spp.), and prairie dogs (*Cynomys* spp.). In 1983 the U.S. Environmental Protection Agency (EPA) banned outdoor above-ground use of strychnine bait due to risks to nontarget wildlife (Federal Register 1983). Among EPA concerns was that endangered and special interest species, primarily mammals and predatory birds, were becoming secondarily poisoned by consuming carcasses of rodents killed by strychnine (Schitoskey 1975). Golden eagles (*Aquila chrysaetos*) for example, have died after consuming prey poisoned with strychnine (Reidinger and Crabtree 1974). The EPA permits strychnine use for pocket gopher and ground squirrel control if concentration in bait is ≤0.5% and baits are placed below ground. Usage modifications were designed to decrease the chances of nontarget species such as raptors consuming bait or becoming secondarily poisoned by consuming poisoned rodents. Nevertheless, nontarget species are still being affected (e.g., Hegdal and Gatz 1976; Fagerstone et al. 1980).

Physiological effects of strychnine are well known. Strychnine is a convulsant poison which acts by lowering the stimulation threshold of spinal reflexes (Casarett and Doull 1980). The LD_{50} (lethal dose for 50% of the treated population) values for a variety of bird species range from about 2.0–24.0 mg/kg body weight (Hudson et al. 1984). Golden Eagle, the only raptor species tested thus far, has an LD_{50} of 4.80–8.10 mg/kg body weight (Hudson et al. 1984).

The objective of this study was to determine behavioral effects of sublethal doses of strychnine on Red-tailed Hawks (*Buteo jamaicensis*) and Great Horned Owls (*Bubo virginianus*). In particular we examined how strychnine influenced behavior. Effects were determined with regard to probable levels of strychnine contamination encountered in the wild. Two types of behavior were of particular interest: First, we wished to ascertain how sublethal doses with physiological consequences would affect future food choices and foraging strategies. Second, we wished to know what other behaviors are affected by ingestion of sublethal toxins beyond taste aversion or motoric influences.

METHODS

Subjects. Two Great Horned Owls (GHO) and one Red-tailed Hawk (RTH) of unknown sex were used in the experiments. One owl (GHO_1) had been maintained in captivity for 13 yrs and had served as a subject in several behavioral experiments. A second owl (GHO_2) and the RTH were wild trapped birds that had sustained injuries to flight feathers and were being rehabilitated. Birds were fed fresh frozen rodents (white laboratory rats) or fresh beef heart daily and were food deprived to approximately 85% of *ad lib* body weight during all experiments. All food was weighed, and subjects were weighed weekly.

Facilities and Maintenance. Subjects were housed individually in 4.8 × 3.0 × 3.4 m wire mesh outdoor cages located at Utah State University, Green Canyon Ecology Research Station, Logan, Utah. Cages shared a wall with an indoor experimental enclosure measuring 9.5 × 7.3 × 3.5 m. Remotely operated

Table 1. Behavioral responses to strychnine. See text for further discussion.

TRIAL #	DOSE (mg) (mg/kg)	BEHAVIORAL RESPONSE
GHO_1		
1–6	0.0	Baseline
7	0.1	No effect
8	0.3	No effect
9	0.5	No effect
10	1.0	No effect
11	1.5 (1.22)	Slight loss of motor coordination
12	1.8 (1.29)	Significant loss of motor coordination
GHO_2		
1–6	0.0	Baseline
7	0.1	No effect
8	0.3	No effect
9	0.5	No effect
10	1.0 (0.83)	Significant loss of motor coordination
RTH		
1–6	0.0	Baseline
7	0.1	No effect
8	0.3	No effect
9	0.5	No effect
10	1.0	No effect
11	1.5	No effect
12	2.0 (1.93)	No effect
13	2.3 (2.09)	Slightly nervous, slightly uncoordinated
14	2.5 (2.33)	Nervous–very unsteady
15	2.8	Significant loss of motor coordination

doors permitted movement from outdoor to indoor enclosures. Experiments one through four were performed outdoors; experiment five indoors.

Experiment One (Exp 1)

Experiment One was designed to establish the minimum oral dosage of strychnine having significant, observable effects on motor functions. To avoid inadvertent stress to birds low doses of strychnine were gradually increased until effects were observable (Table 1). Experiment One also provided an opportunity to characterize precisely the types and extent of behavioral effects of selected dosages.

Exp 1 Procedures. Trials were run on alternate days to allow sufficient time for birds to metabolize or otherwise eliminate the toxin (Goodman and Gilman 1978). Birds were fed white laboratory mice carcasses weighing 22–28 g on test days, and fed sufficient beef heart to meet their metabolic needs for the 48-hr period on non-test days.

Six pre-test trials were conducted to provide baseline behavior data. Birds were fed mice injected with 0.1 ml commercial vegetable oil and observed for 30 min. Posture, excitability, preening, frequency of perch changes, and motor coordination was recorded. At the end of each 30-min observation period an observer walked slowly to the door of each enclosure and recorded the reaction of each bird. Test procedures used were exactly the same as during pre-test, except that mice were injected with 0.1 mg strychnine alkaloid suspended in the vegetable oil. Initial dosage was approximately 1% of the probable LD_{50} for these raptors (Evans and Lindsey 1984) and increased during subsequent trials (Table 1).

Exp 1 Results and Discussion. Behavior during pre-test differed markedly. Owls usually perched motionless for long periods, with their eyes partially closed, typical daytime activity for owls. The hawk was much more active, hopping or flying between perches as many as 48 times during the 30-min observation period. The hawk preened frequently and always appeared alert. When approached at the end of observation periods, the owls became alert, blinked their eyes, snapped their bills, and hissed. One owl (GHO_1) usually remained stationary, whereas GHO_2 often flew against the wire mesh screen and climbed upward one or two m. The RTH became active, was alert and sometimes flew to a perch away from the observer when approached.

At low dosage levels GHO_1 leaned slightly to one side. The most obvious effect of low level dosage was a decrease in motor coordination after brief periods of physical exertion. For example, GHO_1 had difficulty maintaining balance on a perch after a flight of two to three m, sometimes flapping his wings up to 10 sec while attempting to grip the perch. After regaining balance, several more seconds passed before the bird was able to fold its wings. Immediately following these brief periods of faulty balance, both owls appeared normal, including eye-blink, head-turn and other movements. Following flights across the enclosure the abnormal reaction became more pronounced. The owls sometimes could not regain balance and fell to the ground at which time their wings and body trembled uncontrollably for one to 20 sec. Severity of the response appeared propor-

tional to the level of exertion. Owls walked on the ground without difficulty, and walking never triggered trembling. Coordination of flight did not seem to be affected, at least not for the short flights observed within enclosures. Obvious debility of motor coordination and tremors began only after the bird landed or attempted to land. Wings, legs and feet seemed to be affected.

The RTH responded to low level dosage of toxin by becoming more agitated, excitable and slightly uncoordinated. When an observer approached the enclosure the hawk became active and frantically flew against the cage wall. Flights across the enclosure produced similar behavior as observed for GHO_1 and GHO_2. On two occasions RTH fell to the ground after a short flight. Pronounced tremors observed in the owls were not a characteristic reaction of the hawk (Table 1). When the observer withdrew, the hawk rapidly calmed and, like the owls, when perched appeared unaffected.

Experiment Two (Exp 2)

Experiment Two was designed to determine if Great Horned Owls and Red-tailed Hawks would acquire a taste aversion to sublethal quantities of strychnine. Learned taste aversion has been demonstrated in many species (e.g., Garcia et al. 1977; Gustavson 1977). The biological basis for the phenomenon appears related to the fact that many plants and some animals sequester toxins in their tissues as a defense against browsing or predation (Garcia and Hankins 1975; Brower and Fink 1985). Raptors, both captive and free-ranging, may learn to avoid prey items containing strychnine, after one or several sublethal encounters. The question centers about whether gastrointestinal distress is a necessary component of food aversion learning, since strychnine is not known to induce malaise (Gustavson et al. 1979).

Exp 2 Procedures. Experiment Two followed immediately after Exp 1; the last trial of Exp 1 served as the first trial of Exp 2. Subjects and procedures were the same as described for Exp 1. Strychnine dosages were the same as those determined to elicit significant behavioral responses in Exp 1. Weight-specific doses may have varied slightly. The dependent variable was consumption or rejection of a mouse previously associated with strychnine tremors.

Exp 2 Results and Discussion. Owls invariably swallowed mice whole and had little if any opportunity to taste the strychnine (Brett et al. 1976). The Red-tailed Hawk dismembered mice into several pieces but gave no indication that strychnine was tasted.

None of the subjects developed an aversion to mice injected with strychnine and all were quickly consumed. Behavioral response four hr after consumption of the mice was similar to and replicated that described in Exp 1. Raptors were not observed to regurgitate nor were regurgitated mice found in enclosures.

Latency (time between presentation and contact) to take the mouse carcasses did increase slightly as the experiment proceeded. Birds may have become hesitant to eat, but the level of deprivation could not be precisely controlled. In later experiments (see below) birds readily accepted poisoned carcasses suggesting that increased latency in this experiment was not a response to strychnine.

Experiment Three (Exp 3)

Experiment Three was conducted in order to determine if subjects could in fact learn to avert to food injected with a drug that causes gastrointestinal malaise. Inasmuch as strychnine poisoned rodents may die above ground (Hegdal and Gatz 1976; Fagerstone et al. 1980), another and related test was whether the bird averted to the taste of a novel food item or whether sight of a treated food item could cause aversion. Gustavson et al. (1978) reported that "bitter-flavored" dead mice were rejected on-sight by raptors.

Exp 3 Procedures. Subjects were food deprived 24 hr prior to treatment. Each bird was offered a dead black mouse injected with 0.5 ml of lithium chloride solution (0.25 g/3 ml H_2O). Immediately prior to each trial mouse carcasses were placed for 5 min in a solution of white vinegar diluted with an equal proportion of H_2O giving mice both a smell and (presumably) a taste. Birds had not eaten black mice for over four mo prior to Exp 3.

Exp 3 Results and Discussion. Each bird consumed the black treated mice, as well as other untreated food items in five sec or less. Owls clicked their beaks after taking the treated mice, perhaps in response to the vinegar. No noticeable signs of malaise occurred within one hr. No regurgitation of prey was observed, but more than the usual amount of feather fluffing and head turning was noticed.

The following day subjects were offered part of a dead white rat which was consumed within seconds.

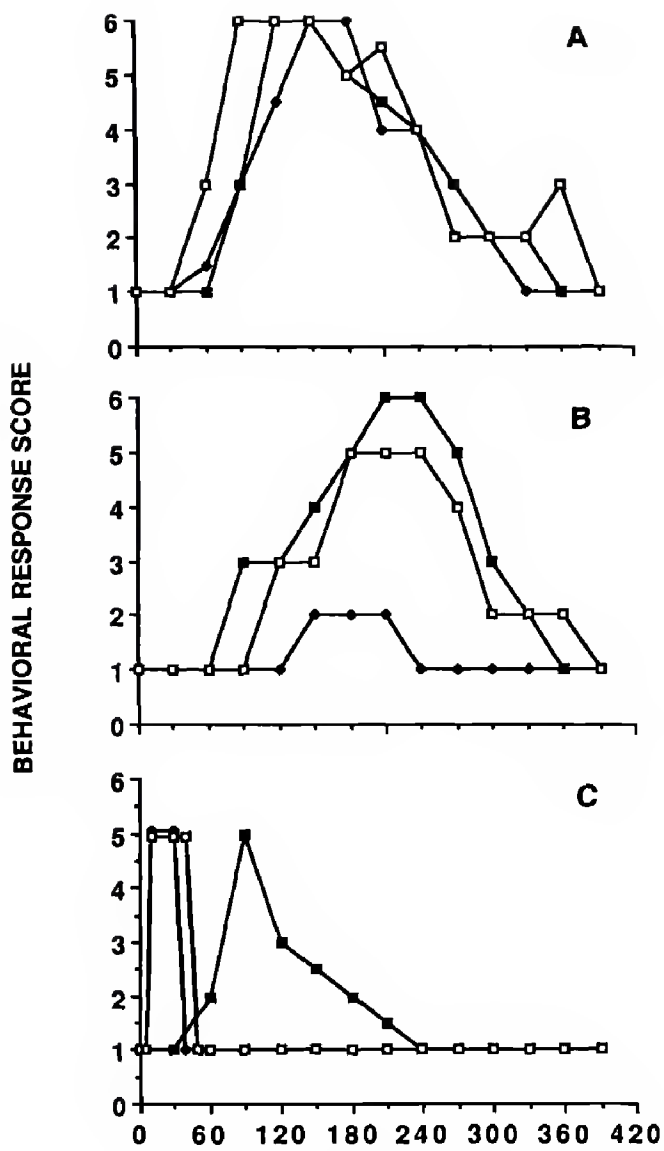

Figure 1. Changes in behavioral response of (A) GHO_1 to 1.8 mg strychnine, (B) GHO_2 to 1.0 mg strychnine, and (C) RTH to 2.8 mg strychnine. Each line represents a separate trial. Behavior response scores are 1, no effect; 2, slightly nervous, slightly uncoordinated; 3, markedly nervous, markedly uncoordinated, no tremors; 4, mild tremors (owls), very nervous (hawk), maintains perch; 5, marked tremors (owls), can't maintain perch; 6, can't stand upright on ground. See text for further explanation.

Dead, black, vinegar-flavored mice were again offered 24 hr later. None of the birds would approach the treated mouse and averted their gaze and even moved away. Odor as a cue cannot be completely ruled out, however, as the vinegar coating gave mice a distinctive smell. Nonetheless, we conclude that raptors will avert to prey treated with lithium chloride.

Experiment Four (Exp 4)

Experiment Four extended Exp 1 to determine the intervals of behavioral response to strychnine, as follows: 1) interval at which behavioral effects first become apparent following treatment; 2) duration of behavioral effects; 3) intensity of behavioral effects; and 4) changes in the intensity of behavioral response over time.

Exp 4 Procedures. Subjects were fed dead laboratory mice injected with strychnine suspended in vegetable oil. Three tests were conducted at 48 hr intervals. Dosages were the same as those that elicited noticeable behavior effects in Exp 1. However, weight-specific doses probably differed slightly from those of Exp 1.

Following treatment subjects were observed for one min periods spaced at 30 min intervals. During each observation period, birds were forced by our presence to fly across enclosures.

Exp 4 Results and Discussion. The RTH reacted to the drug more quickly than did the owls. Initial responses were detected in the hawk in as little as 20 min (two tests) and up to 60 min (one test). Owls initially responded within 60–120 min.

Peak behavioral response occurred in the hawk within 30–90 min. Peak response by GHO_1 occurred 90–150 min after feeding, whereas GHO_2 was affected maximally at 180–210 min. Why the owls differed in reaction time is unknown. Overt recovery in the hawk occurred within 60 min (two cases) and up to 240 min (one case) after feeding. Owls recovered after a 330–390 min period. Duration of observable behavioral effects was much shorter in the hawk (30–210 min) than in the owls (300–360 min).

Intertrial variation in response was greater for two of the three subjects (Fig. 1). Variation may have been due to difference in meal size. For Trials One and Two GHO_2 was fed a 15–20 g mouse containing 1.0 mg strychnine. For Trial Three the same amount of strychnine was given in a 39 g piece of rat carcass. Greater bulk in the gastrointestinal tract may have acted to dilute the strychnine, thereby diminishing effects.

Trial One for the hawk was markedly different than Trials Two and Three (Fig. 1C). The hawk's reaction to the strychnine in Trial One was delayed and of longer duration, similar to responses of the owls (Fig. 1A and 1B). The reason for different responses is not known but may be related to the hawk's feeding behavior. For Trials Two and Three the body cavity (into which the strychnine was injected) was torn open by the hawk before mice were ingested. During Trial One, limbs were consumed

before the body cavity was ruptured. Strychnine would then have been released more gradually and, consequently, absorbed by the gastrointestinal tract over a longer period of time.

Experiment 5 (Exp 5)

Possibly very small quantities of strychnine that have no conspicuous or only minimal effects on behavior might still affect sensory mechanisms or cognitive processes such as learning and memory. Disruption of such processes by an environmental toxin might alter critical behavioral processes such as foraging efficiency, mating activities, and other reproductive behavior. The purpose of Exp 5 was to establish whether sensory and cognitive processes were altered at low oral dosages. Two of the birds were trained to perform a relatively complex foraging task that required cognitive skills. Birds were then treated with small quantities of strychnine and observed during task performance.

Exp 5 Procedures. The procedure utilized is called reward following or reversal learning (Mackintosh 1974). A piece of rat carcass was placed in one of two closed prey chambers with an electronic perch in front that caused chamber doors to open when a subject landed (Cheney 1979). Each subject was allowed to choose a chamber. A food item was placed in the same chamber for all trials until three correct first choices were made in succession. The food item was then placed in an alternative chamber and trials repeated until the bird made three correct choices in succession. This procedure develops a win-stay, lose-shift strategy in most organisms such that with experience a reversal in choice behavior occurs after the first encounter of an empty chamber. Dependent measures with this procedure include latency to choose a chamber, latency to strike (see below), and perseveration after reaching criteria.

Procedures during pretesting and testing were similar. Trials were repeated at 24-hr intervals. Two hours prior to each trial birds were fed a 5–10 g piece of white rat carcass. During pretest, food was injected with 0.9 ml of plain vegetable oil. During testing, food was injected with strychnine suspended in the same type and amount of vegetable oil. Dosages were approximately 10% of the reported LD_{50} for Red-tailed Hawks and Great Horned Owls (Anthony et al. 1983): 1.0 mg for RTH and 0.8 mg for GHO_1.

At the beginning of each trial a 20–30 g piece of rat carcass was placed in one of the two food chambers. Each bird was observed by means of a television monitor. Interval between the bird entering the room and selection of a food chamber (opening of the lid) was recorded as were other features of the bird's performance and behavior. If the bird opened the lid of the baited food chamber first, that choice was recorded as correct. If the empty food chamber was opened first, the bird was allowed to open the other prey chamber.

After a correct choice was made, subjects were allowed to eat the food. Each bird was then allowed a maximum of five min to search the other box if it had not already done so. If the bird made no attempt to search for food in the other chamber within 5 min, the door to the outdoor enclosure was opened, permitting the bird to leave.

Exp 5 Results and Discussion. During pretest and test trials, both raptors perched quietly in the experimental enclosure for one to 30 min before choosing a food chamber. The hawk usually perched on a horizontal perch 0.5 m from the electronic perch for Chamber Two, which did not seem to influence the hawk's selection of food chambers. Usually GHO_1 perched across the room and flew to a horizontal perch near the electronic perches just prior to selecting a prey chamber.

The hawk underwent 50 pre-test trials prior to testing and GHO_1 underwent 62 pretest trials. Initially choice of food chambers was random and inconsistent. After the hawk's thirty-first trial and the owl's forty-eighth trial, choice behavior became consistent. The last 19 pretest trials of the hawk and 14 pretest trials of the owl are shown in Figure 2. During trials for the hawk, food was switched from Chamber One to Chamber Two back to Chamber One and then back to Chamber Two. The hawk successfully "tracked" the food making only one, four, and two incorrect choices following each switch, respectively. The minimum number of errors possible is one for each switch, so the hawk made between zero and three errors more than the minimum. During the owl's last 14 pretest trials, the food was switched from Chamber Two to Chamber One and back to Chamber Two. The owl also successfully "tracked" the prey, making only two incorrect choices following the first switch (one more than the minimum) and three incorrect choices following the second switch (two more than the minimum) before making three consecutive correct choices.

Initiation of treatment (i.e., ingestion of strychnine-treated mice two hr prior to choice tests) was

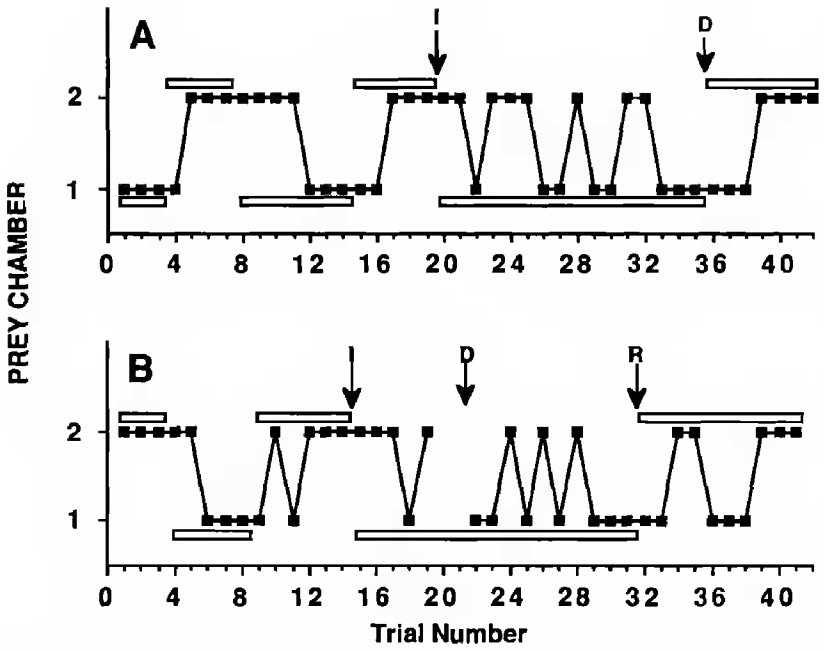

Figure 2. Choice of prey chambers by (A) RTH and (B) GHO_1. The open horizontal bars indicate the location of prey. Prey location was switched after three consecutive correct choices. The line connecting closed squares illustrates choice of prey chambers. For RTH strychnine (1.0 mg) was initiated (I) on Trial 20 and discontinued (D) on Trial 36. For GHO_1 strychnine (0.8 mg) was initiated (I) on Trial 15. On Trials 20 and 21, GHO_1 failed to respond to the test protocol, apparently due to accumulating toxic levels of strychnine in its system. On Trial 22 strychnine was discontinued and reinitiated (R) on Trial 32 at 0.4 mg. See text for further explanation.

coincident with switching food to the alternate chamber. The hawk's weight during Exp 5 ranged from 1147–1189 g ($\bar{x}$ = 1163 g), and the weight-specific dose was 0.86 mg/kg strychnine. GHO_1's weight ranged from 1171–1256 g ($\bar{x}$ = 1228 g) with a weight-specific dose of 0.65 mg/kg in the early phase of the test and 0.32 mg/kg in the later phase.

During Exp 5, the hawk made 13 choices before making three consecutive correct choices (Fig. 2A). Eight choices were incorrect. The overt behavior of the hawk did not seem to be affected by the strychnine but results indicate that memory and learning may have been degraded. Following three consecutive correct choices (Trials 33–35), the administration of strychnine was discontinued. The hawk then made only three incorrect choices before switching to the correct food chamber, an error rate similar to the pretest situation.

The first attempt to test GHO_1 was terminated because the owl was accumulating strychnine. GHO_1 made five choices during the first test before acquiring toxic levels of strychnine. On Trials 20 and 21, GHO_1 was unable to carry out the test protocol (Fig. 2B), even though lower doses of strychnine were given than in Exps 1 and 2. The toxin was given at 24 hr intervals rather than 48 hr intervals and was apparently accumulating faster than could be eliminated. Administration of the drug to GHO_1 was discontinued on Trial 22. On Trial 29, GHO_1 again established consistent choice behavior. On Trial 32, following three consecutive correct choices, administration of strychnine was again given to GHO_1 but at a reduced level of 0.4 mg. GHO_1 then made seven incorrect choices before meeting contingency, six more than the minimum required and 4.5 more than its pretest mean. We conclude from this experiment that repeated ingestion of strychnine had a modest effect on foraging behavior at dosages of 0.4 mg and a profound effect at dosages of 0.8 mg.

DISCUSSION

Dosages of strychnine alkaloid of 0.8–2.3 mg/kg had substantial effects on behavior of the birds tested. The Red-tailed Hawk appeared less sensitive to strychnine than did the Great Horned Owls, and the two species had markedly different behavioral responses. The Red-tailed Hawk became highly agitated and uncoordinated at doses of 2.3 mg/kg but only once developed tremors. Evans and Lindsey (1984) stated that Red-tailed Hawks are physically affected by 4.5–5.0 mg/kg strychnine. Our results indicate that at least some Red-tailed Hawks can be affected by much smaller doses.

Behavioral responses of the Great Horned Owls were more severe than the hawk's although drug dosage was lower (0.8–1.3 mg/kg). Noticeable loss of coordination and tremors developed. Evans and Lindsey (1984) reported that 2.0–2.5 mg/kg of strychnine has an adverse physiological effect on Great Horned Owls. In our study response to the drug was greatest immediately after prolonged or intense physical exertion. Minimal exertion, such as head-turning, eye-blinking and slow walking, did not trigger tremors. Casarett and Doull (1980) reported that strychnine acts by lowering the threshold for stimulation of spinal reflexes, causing tetanic convulsions. Minimum threshold in our study was exceeded by owls flying across enclosures or flapping their wings vigorously.

Lethal dose (LD_{50}) of strychnine alkaloid has been estimated to be 10.2 mg/kg for Red-tailed Hawks and 7.7 mg/kg for Great Horned Owls (Anthony et

al. 1983). Our results indicate that doses causing a significant behavioral response were 10–16% of the estimated LD_{50} for Great Horned Owls and 28% of the estimated LD_{50} for the Red-tailed Hawk. Experiment 5 revealed that at a dose of 0.86 mg/kg (8.6% of estimated LD_{50}) the Red-tailed Hawk was much less accurate on a choice test than during pre- and post-tests (no drug). At a dose of 0.32 mg/kg (4.0% of estimated LD_{50}), GHO_1 was also less accurate than during pretest (no drug). Thus, sublethal concentrations of strychnine alkaloid have potentially important behavioral consequences for these raptors.

Raptors and other predators may encounter sublethal doses of strychnine in the wild by eating strychnine-poisoned rodents (e.g., Fagerstone et al. 1980; Evans and Lindsey 1984; Barnes et al. 1985; Anthony et al. 1983). Predicting behavioral effects likely to be experienced by wild raptors ingesting strychnine is complicated by a number of factors. First, we observed considerable inter- and intraspecific variation in response to strychnine. Second, feeding behavior appears to influence how strychnine is absorbed by the gastrointestinal tract. Raptors that dismember prey and ingest viscera are likely to absorb the toxin more quickly and over a shorter time period, thus intensifying effects. Whether the predator's susceptibility to strychnine poisoning is increased is not clear. On the other hand, if the raptor rejects viscera, susceptibility to strychnine poisoning should decrease as most of the toxin in strychnine-killed rodents remains in the gastrointestinal tract (Hegdal et al. 1980; Evans and Lindsey 1984). Third, meal size may influence level of toxicity. In our study a given quantity of strychnine in a large meal had much less effect than did the same dose in a small meal. A large amount of food in the gut may dilute the toxin allowing it to be metabolized or eliminated with fewer behavioral consequences. On this basis an otherwise "lethal" dose may be survivable if ingested in a large meal. Fourth, even though strychnine is metabolized or eliminated relatively quickly, complete elimination may take several days. However, if low doses of strychnine are repeatedly ingested over a long period of time, the toxin appears to accumulate in the system faster than it can be eliminated and may eventually influence behavior. Fifth, the physiological impact of a given dose may vary seasonally. Casarett and Doull (1980) reported that cold temperatures have a potentiating effect on strychnine. A given dose of strychnine ingested in winter or early spring will have a greater effect on behavior than the same dose ingested in summer. In addition we found that activity following ingestion contributes to how dramatic the effects will be.

Even though raptors eventually recover from sublethal doses of strychnine with no long-term detrimental effects, ingestion of small doses can have potentially harmful consequences. Birds tested in our study occasionally fell from perches after ingesting low doses of strychnine in food. In the wild a fall from a perch could be fatal or could render birds vulnerable to predation. Further, sublethal doses of strychnine may substantially alter foraging behavior. Effects of strychnine on other aspects of behavior and physiology (e.g., temperature regulation) should also be explored.

Taste aversion to strychnine-contaminated food can have both good and bad consequences. On one hand, it is perhaps fortuitous that a prey base is not removed through aversion, while on the other hand, repeated and frequent ingestion of poisoned items can have serious effects. The ultimate outcome will probably depend upon individual conditions present at time of exposure.

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